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The Role of Executive Functioning in Significant Behavioral Dysregulation Among Children in an Inpatient Psychiatric Hospital

Lauren D. Haisley
University of Connecticut - Storrs, lauren.haisley@uconn.edu

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Lauren Haisley, Ph.D.

University of Connecticut, 2017

Physical restraints and seclusions (R/S) within a psychiatric inpatient setting remain highly controversial interventions that are used in response to a child's dysregulated, and unsafe behaviors. Previous studies have identified a range of risk-factors that increase a child's likelihood of experiencing R/S during their inpatient admission, however no study to date has examined whether a child's executive functioning (EF) predicts R/S. Thus, the two aims of the current study were 1) to examine the relationship between children's observable behavior dysregulation (R/S) and performance on formal measures of EF, and 2) to identify which demographic, psychiatric or neurocognitive factors place a child at greater risk for experiencing R/S during his/her inpatient admission. Participants included 271 children who were consecutively given a neuropsychological assessment on the Children's Inpatient Unit at Emma Pendleton Bradley Children's Hospital between 2010-2015. The total count of each R/S type (hold, escort, time in seclusion and mechanical restraint) was recorded from the child's medical record for the current admission. A series of negative binomial regressions predicting each type of R/S were conducted. When EF skills were examined independently from demographic or psychiatric variables, lower scores on the Stroop Color Word task significantly predicted greater holds, escorts, and mechanical restraints. Counter to hypothesis, higher scores on the Wisconsin Card Sorting Task-Categories predicted more holds, escorts, seclusion time and mechanical restraints. However, when significant demographic and psychiatric variables were added to the models, children's R/S were most predicted by the child's age, race/ethnicity, history of an out-

of-home placement (residential program) and history of aggression. Results are discussed in the theoretical context of the relationship between EF measures and behavior regulation, as well as in the context of inpatient psychiatric treatment.

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Lauren D. Haisley

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The Role of Executive Functioning in Significant Behavioral Dysregulation Among Children in an Inpatient Psychiatric Hospital

Presented by

Lauren D. Haisley, B.A., M.A.

Major Advisor _____

Marianne Barton, Ph.D.

Associate Advisor _____

Jeff Burke, Ph.D.

Associate Advisor _____

Karen Holler, Ph.D.

University of Connecticut

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Child Psychiatric Inpatient Hospitalization

Between 13- 20% of children in the United States experience a mental health condition in a given year (Perou et al., 2013). Psychiatric hospitalization is generally seen as a last resort for children who are experiencing significant distress due to a mental health condition; hospitalization may result from behavior suggesting that the child is dangerous to him/herself or others. Inpatient psychiatric hospitalization remains the most costly and restrictive intervention available for children and adolescents with severe emotional disorders (James et al., 2010).

The utilization of psychiatric hospitalization for children has changed over the past several decades. Between 1988-1996, the number of children admitted to hospitals for mental health reasons increased; however by the year 2000 this number had stabilized (Case, Olfson, Marcus, & Siegel, 2007; Pottick, McAlpine, & Andelman, 2000; Torio, Encinosa, Berdahl, McCormick, & Simpson, 2015). From 1990-2000, the United States also saw a relative decrease in children's average length of psychiatric hospitalization, which experts suggest was due to the expansion of behavioral managed care and an increase in the use of psychotropic medication for children. However, since the year 2000, psychiatric hospitalization has again been on the rise. A recent report on health care utilization for children with mental health conditions between 2006-2011 found that the number of inpatient hospitalizations related to a mental health disorder increased by 66% (Torio et al., 2015). It is unclear from the literature the number of hospitalizations accounted for by readmissions, as there has been a documented increase in the number of children rehospitalized after their initial hospital admission (James et al., 2010).

Within the context of inpatient psychiatric hospitalization, there exists a polarizing issue, the use of physical restraint and seclusion (R/S). A restraint is the use of physical intervention to hold or guide the child, whereas seclusion is placing a child in a specific room with the goal of deescalating dangerous behavior. R/S are often used in response to aggression and behaviors that jeopardize the safety of patients and staff (Busch & Shore, 2000; Duke, Scott, & Dean, 2014). Day (2002) reviewed the rationales given for using R/S, and found seven frequently cited justifications:

> (a) to prevent a child who is acting out of control from harming himself; (b) to prevent him from harming others, including staff or other patients; (c) to prevent him from damaging property; (d) to bring a sense of control to a unit; (e) to respond to a rule violation or other acts of noncompliance; (f) to use when other, less restrictive methods have proven ineffective; and (g) to promote self-control and enhanced coping skills (pg.269)

The use of R/S in psychiatric inpatient settings has long been criticized due to their invasive quality, potential to cause physical harm, as well as their conceivably detrimental effects on treatment (De Hert, Dirix, Demunter, & Correll, 2011; Masters & Bellonci, 2002). Due to these significant risks, the use of R/S in child psychiatric contexts has long been debated (LeBel et al., 2004), with some professionals maintaining that R/S remain necessary for both safety and even therapeutic reasons (Dean, Duke, George, & Scott, 2007a). Proponents suggest that R/S help to build self-regulatory abilities and coping skills, as well as protecting staff and patients from harm. However, the

effectiveness of these intrusive interventions has been understudied, especially in the long-term (Day, 2002; Crocker, Stargatt, & Denton, 2010; Fryer, Beech, & Byrne, 2004).

The issue gained national attention after a series of articles published in the Hartford Courant (Weiss, 1998) documented 142 deaths related to physical restraint and seclusion occurring from 1988-1998. Twenty-six percent of these deaths were children. The series prompted federal agencies to publish requirements for federally funded hospitals (accepting Medicare or Medicaid). These regulations include the following: 1) R/S may only be used to ensure safety, 2) staff must be trained in safe R/S procedures 3) with few exceptions, a physician or licensed clinician must order the R/S 4) implementation of age-dependent time limits, 5) mandatory post-R/S check-ins and monitoring, and 6) documentation and parental/caregiver notification, (National Association of State Mental Health Program Directors; NASMHPD, 1999; Child Health Act, 2000; Health Care Financing Administration; 2001). Additionally, mental health organizations, most notably the American Academy of Child and Adolescent Psychiatry, have asserted their own recommendations to reduce the use of R/S, including training in de-escalation procedures and more effective treatment planning.

However, despite policy changes and recommendations in the United States and other countries (e.g. Australia, Finland), the prevalence of R/S within child psychiatric inpatient settings remains highly variable. DeHert and colleagues (2011) conducted a literature review addressing the prevalence of R/S in child psychiatric settings between 2000-2010. Their review revealed uneven use of R/S, with 8.5–61% of admitted children being secluded, and 7.6–47% experiencing a restraint. Thus, mental health professionals have continued to work at decreasing the use of R/S within the inpatient setting. One line

of research has examined the child-level factors related to a higher incidence of R/S during an inpatient stay. By understanding which children are more likely to experience R/S, mental health professionals may be able to target these children with more effective treatment and preventative measures (Crocker et al., 2010).

Several studies have assessed for child and family-level correlates of R/S in various psychiatric inpatient settings within the United States, Finland and Australia. It is difficult to compare the results of these studies, as they are conducted across multiple hospitals, states and countries with differing rules, regulations and programs governing the use of R/S. These differences may account for their somewhat different conclusions. For example, results are equivocal about the implication of age; with some showing that younger children are more likely to experience seclusions (Dean, Duke, George, & Scott, 2007b; Gullick, McDermott, Stone, & Gibbon, 2005; Stellwagen & Kerig, 2009), restraints (Sourander, Ellilä, Välimäki, & Piha, 2002) or R/S combined (Pogge, Pappalardo, Buccolo, & Harvey, 2013); others have found that older children experience higher rates of R/S (Martin, Krieg, Esposito, Stubbe, & Cardona, 2008; Sourander et al., 2002), or found no association at all (Crocker et al., 2010). Comparison is additionally complicated by the fact that inpatient units can consist of age subsets anywhere between 4 and 17 years of age.

Among studies conducted in the United States after the year 2000, child-level factors including male gender (Martin et al., 2008), African American or Hispanic racial or ethnic identity (Martin et al., 2008), a history of aggression (Dean et al., 2007b; Tompsett, Domoff, & Boxer, 2011), a history of being abused (Dean et al., 2007b) and previous hospitalizations (Tompsett et al., 2011) have all been associated with increased

R/S. At the family level, being on Medicaid (Martin et al., 2008) and the child being in an out-of-home placement (i.e. residential facility; Dean et al., 2007b) are also positively related to R/S. Due to the disparate factors examined, the current study seeks to replicate each of these findings.

Citing that lower cognitive abilities are often associated with aggressive behavior in youth, Tompsett and colleagues (2011) examined the cognitive skills, using the WISC-IV, of 66 children in their sample. They did not find an association between any of the four major indices (Verbal Comprehension, Perceptual Reasoning, Working Memory and Processing Speed), and experience of R/S. Similarly, Stellwagen and Kerig (2010) found no association between verbal skills, as measured by the WASI, and increased R/S. No studies have looked at the contribution of other neurocognitive factors to the frequency of R/S in a child population.

Executive Function and Self-Regulation

When thinking of children who exhibit behavioral impulsivity and emotional dysregulation such as those who may frequently experience R/S on an inpatient unit, we may be quick to blame deficits in the neuropsychological skills called "executive functions." The construct Executive Function (EF) has cycled through many operational definitions from its conception as the function of the prefrontal cortex (PFC) as early as the 1840's (Barkley, 2012). Recently, Russell Barkley (2012), called for the use of a single, agreed-upon definition across psychological research and clinical practice. Similarly, child-focused researchers have called for the integration of "executive control," frequently used in temperament and personality literature, and "executive function," most often used in cognitive neuroscience and clinical psychology, into a

single framework through which to understand self-regulation (Blair & Razza, 2007; Zhou, Chen, & Main, 2012). Barkley proposed that EF is broadly "self-regulation to achieve goals" or more specifically, "those self-directed actions needed to choose goals and to create, enact, and sustain actions toward those goals" (page 60). Adele Diamond describes EF as "a family of top-down mental processes needed when you have to concentrate and pay attention, when going on automatic or relying on instinct or intuition would be ill-advised, insufficient, or impossible. Using EF is effortful; it is easier to continue doing what you have been doing than to change, it is easier to give into temptation than to resist it, and it is easier to go on "automatic pilot" than to consider what to do next." (page 135; 2013). Although there has been some debate, EF is generally thought to encompass three primary factors: inhibition, working memory (WM) and cognitive flexibility (Diamond, 2013; Miyake et al., 2000; Nigg, 2016).

Inhibition, or inhibitory control, is the ability to control one's thoughts, behaviors and emotions, to choose the desired response over the automatic one. Inhibitory control helps us to choose what we attend to and how we act/react (Diamond, 2013). This is thought to be the first EF skill to develop, with developmental studies identifying the preschool years as a significant period of growth for inhibitory control (Best & Miller, 2010). Early neuroimaging indicates global cortical activity during inhibition tasks (8 months of age), with increased specificity to medial frontal regions in middle childhood and eventually the right ventrolateral prefrontal cortex (rVLPFC) in adulthood (Best & Miller, 2010; Cohen, Berkman & Lieberman, 2013).

Working memory refers to the ability to hold information in mind and perform operations with/on that information. Working memory helps us to remember instructions,

to incorporate new information into our action plans, and allows us to reason (Diamond, 2013). Working memory abilities develop along a more linear trajectory from preschool through adolescence. Similar to inhibition, imaging work demonstrates a pattern of proliferation and then specification, with WM skills localizing in the dorsolateral-prefrontal cortex (DL-PFC; Best &Miller, 2010).

Cognitive flexibility is said to build upon inhibition and WM, and allows us to switch between mental sets. Cognitive flexibility helps us to try novel solutions to problems, and adjust our approach to tasks depending on situational parameters. Cognitive flexibility/set shifting is indistinguishable from the constructs of inhibition and WM in preschoolers, thus it is likely established later in development and relies on the solid formation of inhibitory control and WM skills (Best & Miller, 2010; Garon, Bryson & Smith, 2008; Senn, Epsy & Kaufmann, 2004). Research suggests that this skill continues to develop through adolescence and even into early adulthood; children are able to process increasingly complex shifting tasks with greater accuracy as they develop (Best & Miller, 2010). Cognitive flexibility involves neural activity in multiple regions including the anterior cingulate cortex (monitoring performance, detecting conflict), medial PFC (processing conflict), left dorsal PFC (hypothesis testing and adjusting behavior) as well as being reliant on connections with the parietal lobe (basic attentional processes; Crone, 2007; Jurado & Roselli, 2007; Rubia et al., 2006).

These EFs are important to self-regulation in a top-down fashion, while being dependent on bottom-up processes such as basic attention, emotion and stress arousal. Thus although EF are frequently understood as functions of the prefrontal cortex, they

depend on the integrity of connections between frontal and posterior areas, as well as connections with subcortical and thalamic structures (Jurado & Rosselli, 2007a) .

EF is often measured using performance-based tasks (for example, Wisconsin Card Sorting Task or Stroop Color Word Test) or behavior rating scales (for example, Behavioral Rating Inventory of Executive Functioning; BRIEF). Although these two types of measurement are suggested to access the same underlying EF constructs, recent literature has suggested that this is not the case (Toplak, West, & Stanovich, 2013). In their review, Toplak and colleagues found minimal evidence for the correlation between performance-based and rating scales that is frequently assumed. Instead, they suggest that "performance measures may indeed be assessing something of genuine importance, namely the efficiency of the processes available to recruit in behavioral control, such as inhibition, but performance- based measures bypass the whole issue of rational goal pursuit" (pg. 137). Thus, performance-based measures provide a window into the specific skills a child may recruit from in order to carry out more broad tasks of self-regulation.

Executive Function Development and Aggression

As stated above, the main rationales given for using restrictive intervention within a child psychiatric environment are to prevent a child from harming himself, others, or property (Day, 2002). Thus, R/S are often utilized in reaction to overtly aggressive behavior. The literature on childhood aggression suggests that EF skills may play a significant role (Coolidge, DeBoer, & Segal, 2004; Ready, Stierman & Paulsen, 2001; Santor, Ingram, Kusumaker, 2003; Utendale & Hastings, 2011), and thus we may glean important information surrounding behavior regulation more broadly from examining this line of research.

Although aggression is common in early childhood (toddler years), a reduction in aggressive behavior is often seen around the time that major gains in EF are made (Segun & Zelazo, 2005). Additionally prefrontal dysfunction has been associated with an increase in aggression and antisocial behavior in adults (Brower & Price, 2001; Lapierre, Braun, & Hodgins, 1995). Several studies have assessed EF using caregiver-report measures such as the BRIEF or the Child Behavior Questionnaire (CBQ; Coolidge et al., 2004; Ready, Stierman & Paulsen, 2001; Utendale & Hastings, 20011); however, some have utilized performance-based tasks (Granvald & Marcisco, 2016; Riccio, Hewitt & Blake, 2011). Lower working memory (Giancola, Mezzich, & Tarter, 1998; Granvald & Marcisco, 2016), disinhibition (Coolidge et al., 2004; Utendale & Hastings, 2011), and poor cognitive flexibility (Segun et al., 2002) have been predictive of overt aggression in childhood and adolescence, with moderate effect sizes. Some authors hypothesize that deficits in EF interfere with a child's ability to engage in social problem solving (Eisenberg & Morris 2002; Lough et al. 2001; Zelazo et al. 1997; Zelazo and Müller 2002), and thus contribute to a rise in aggression. Although not all R/S are precipitated by overt aggression, the negative association between EF and physical aggression recommends that deficits in EF skills may also lead to increased experience of R/S.

Executive Function Development and Trauma

Children who experience early childhood stress and develop in an environment characterized by poverty, neglect and/or early trauma often do not develop self-regulation skills to the same degree as their peers (Lengua, Honorado & Bush, 2007; Maughan & Cicchetti, 2002; O'Connor et al., 2000; Shonkoff, et al., 2012). Continuous stress negatively impacts the developing body's "stress response systems," specifically the

hypothalamic-pituitary-adrenal axis (HPA axis), which can create lasting neurological changes (Lupien, McEwen, Gunnar, & Heim, 2009). These neurochemical changes interrupt normal functioning of the limbic system, as well as the prefrontal cortex, which in turn disrupts the skills that stem from their functioning and integration, potentially derailing executive functioning skills (Goldsmith & Davidson, 2004). Imaging studies identify decreased volume in the prefrontal cortex (Andersen et al., 2008; Carrion et al., 2010; De Bellis et al., 2002), hippocampus (Andersen et al., 2008; Dannlowski et al., 2012), and corpus callosum (Andersen et al., 2008; De Bellis et al., 2002) among children with a history of trauma.

Early trauma has been related to deficits in inhibitory control (Beers & DeBellis, 2002), cognitive flexibility (Beers & DeBellis, 2002), sustained attention (Beers & DeBellis, 2002), planning/organization (DeBellis et al., 2013; Kavanaugh & Holler, 2014) and EF composite scores (DePrince, Weinzierl, & Combs, 2009) in children and adolescents.

The current study seeks to delineate how environmental factors such as early trauma or deprivation are related to EF, and how these two inter-related domains contribute to behavioral dysregulation.

Executive Functioning in Children Undergoing Psychiatric Hospitalization

Children admitted for an inpatient psychiatric stay, have frequently demonstrated unsafe behaviors in their home or community; for example, becoming aggressive with a family member, engaging in self-harm, throwing objects or threatening others. Although these behaviors frequently lessen within the structured environment of the hospital, some children continue to demonstrate significantly dysregulated and unsafe behaviors. If

unsafe behaviors occur, staff may use physical restraint or seclusion in order to maintain safety. Dysregulated behaviors suggest that a child struggles to inhibit impulsive actions, problem solve, shift his/her attention away from his/her internal state, or regulate his/her emotions. As these skills are frequently thought to be subsumed under the umbrella of "executive functioning," theoretically one may hypothesize that these children would have deficits in EF as measured by our standardized measures, however this has not been empirically shown. Despite the potential link between EF and severe behavioral dysregulation, only one study has examined what neuropsychological assessments may be able to tell us about this kind of behavioral dysregulation.

Comas (unpublished thesis; 2012) examined whether EF or effortful control moderated the relationship between childhood sexual abuse and the number of R/S that 46 adolescents experienced during psychiatric hospitalization. EF was operationalized as the adolescent's performance on the D-KEFS Color-Word Interference Test. Effortful control was operationalized as the adolescent's aggregate Attention and Inhibitory Control subscale scores, as provided by the clinician-completed Early Adolescent Temperament Questionnaire – Revised (EATQ-R). Sexual abuse history was significantly related to the overall proportion of R/S as were effortful control scores on the EATQ-R; however, inhibitory skills on the D-KEFS Color-Word Interference Test were not. Additionally, inhibitory skills did not moderate the relationship between sexual trauma and R/S. Effortful control was a significant moderator. While the results of this study should be considered, it was limited by a small sample size, significant missing data and the use of a single EF measure.

Similarly, Bridgett, Valentino, Hayden (2012) combined the EATQ-R Effortful Control score with the total time children took to complete D-KEFS Color-Word Interference and D-KEFS Color-Word Switching tasks, to create an "effortful control composite score." Controlling for covariates such as age, gender, maltreatment history, depressive symptoms and history of dysregulated behavior, their effortful control composite score significantly predicted children's R/S in a psychiatric inpatient setting.

Statement of the Problem

The questions addressed by this dissertation are twofold. The first issue is theoretical in nature: how is observable behavioral dysregulation related to EF as measured by our neuropsychological tests? Restraints and seclusions within the inpatient psychiatric setting represent an adult response to extreme behavioral and emotional dysregulation in children. The frequency of R/S may be used as an index of severity for behavioral dysregulation. Based on our theoretical understanding of EF, we might expect that children who are exhibiting extreme deficits in self-regulation may also have deficits in EFs such as working memory, impulse inhibition and set-shifting. However, these relationships are often less straightforward than we might expect, as there is never a 1:1 correlation between the two. As previously discussed, a child's basic cognitive skills (basic attention, IQ) and environmental/psychiatric variables (stressors, trauma) may affect self-regulations skills. In an effort to better describe brain-behavior relationships, the current study offers a window into the relationship between neurocognitive functioning and behavioral outcomes, while accounting for both basic cognitive skills and environmental/psychiatric factors.

The current study offers a large, well characterized group of children that will shed light on whether EF are related to significant behavioral dysregulation, but also specifically **which** EF skills are associated with R/S. The additional histories I have for each child will allow me to look at how EF interacts with these demographic/psychiatric variables and lead to behavioral outcomes.

Secondly, as delineated above, repeated R/S can have deleterious effects on a child's mental health and has the potential to be re-traumatizing and physically harmful. By better understanding which children are subject to repeated R/S, we can seek to alter treatment and to better address the needs of these children. Only one study to date (an unpublished thesis; Comas, 2012) has examined the relationship between neuropsychological assessment data and R/S data; therefore, this is a notable gap in the literature that the current study seeks to fill.

Finally, it should be noted, that children were referred for neuropsychological testing by their psychiatrist or treatment team; not all children in the inpatient unit received neuropsychological testing. In order to examine how generalizable my results are to the broader inpatient population, I additionally assessed for any systematic differences between children referred for testing, and those who were not (see Methods section).

Specific Areas of Inquiry

1. Replicate previous studies by examining which psychiatric and demographic characteristics are related to R/S, including: age, gender, race/ethnicity, SES (public vs. private insurance), out-of-home placement, history of aggression, and the experience of early trauma.

2. Examine which, if any, EF scores on neuropsychological tests are related to R/S.
3. Assess whether EF scores moderate the relationship between factors such as out-of-home placement and behavioral dysregulation (R/S).
4. Examine the generalizability of the sample of children who received neuropsychological assessment, by comparing demographic factors of children referred for testing, and those who were not.

Hypotheses

1. Demographic and psychiatric characteristics will be related to increased R/S.
    a. Males will experience more R/S than females.
    b. Children with a history of out-of-home placement will experience more R/S.
    c. Children with a history of maltreatment will experience more R/S.
2. EF scores will be related to the number of R/S. Specifically scores on tests of inhibition and cognitive flexibility/set shifting will be negatively related to behavioral dysregulation.
3. EF scores will moderate the relationship between demographic factors and the number of R/S.

Methods

Participants

The current study was conducted at Emma Pendleton Bradley Children's Hospital on the Children's Psychiatric Inpatient Unit. Participants include those assessed by the investigator, as well as data from a retrospective medical chart review. The final data set

includes children (n=271), who were consecutively given a neuropsychological assessment on the Children's Inpatient Unit at Bradley Hospital between 2010 and 2015, and who met inclusion criteria (referred to as the NP group). Children were generally referred for neuropsychological assessment by their psychiatrist shortly after admission in order to answer diagnostic questions and inform treatment; for example, to assess the child for Attention Deficit Hyperactivity Disorder (ADHD), a language disorder, or to better understand the child's unique profile of strengths and weaknesses. Additionally, data from a group of 140 children admitted to the children's inpatient unit during the same time period, who were **not** referred for a neuropsychological evaluation, were examined (No-NP group). This comparison was used to clarify any systematic differences between children referred for a neuropsychological evaluation and those who were not, and therefore inform the generalizability of any findings. Children were excluded from the current study if the researcher was unable to find R/S documentation (n = 13), or if records indicate that a child received an assessment (n=8), but the data could not be found.

Measures

Data was collected via retrospective chart review including paper and electronic medical records. Records consulted include an admission summary, documentation of each R/S incident, neuropsychological testing data summaries, and discharge summary.

Demographic data.

Age. Participant's age in months was calculated and recorded based on the date of neuropsychological testing.

Sex. Participant's sex was identified via chart review.

Race/ethnicity. Participant was identified as one or multiple of the following: Caucasian/White, African American/Black, Hispanic, Asian or Not Reported.

Current family environment. Information about the child's living situation directly prior to hospitalization was gathered during his/her intake evaluation, and documented in the medical chart. For the purposes of the current study, this was further broken down into "in- home" or "out-of-home" placements. Out-of-home placements included only residential settings, in-home settings included all settings in which a child was living with family (including adoptive/foster family or extended family members).

Family history of psychiatric/substance disorders. During inpatient admission, caregivers were asked about family history of psychiatric disorders and substance abuse. This information was documented in the intake evaluation in the medical chart.

Insurance type. Insurance provider was consistently documented in the child's medical record. Therefore, having public (Medicaid) versus private insurance (e.g. Blue Cross Blue Shield) was used as a broad (albeit incomplete) metric for SES.

Intake diagnosis. Previous diagnoses were documented in the child's intake evaluation; if a child did not have a previous diagnosis, appropriate diagnoses were given based on information provided during intake. For the current study, diagnoses were grouped into relevant categories including ADHD, Mood Disorder, Externalizing Disorder (Oppositional Defiant Disorder, Conduct Disorder, Intermittent Explosive Disorder), PTSD, ASD, Psychosis, and Language Disorder.

Concerns at admission. Concerns at admission were documented in the intake evaluation. Documented concerns included: suicidal ideation, homicidal ideation, aggression/assaultive behavior, self-injurious behavior, sexualized behavior.

Neuropsychological assessment. Children in the NP Group were given a flexible battery of neurocognitive tests covering basic cognitive, language, memory, attention, executive function and fine motor skills. Only relevant cognitive and EF measures were used for the purpose of this study.

Cognitive measure. Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999) is a short 4-subtest intelligence scale providing both a Verbal Comprehension Index (VCI) and a Perceptual Reasoning Index (PRI), in addition to an overall Full Scale IQ. The measure was written to correspond with WISC-III and WAIS-III ("Wechsler Adult Intelligence Scale--Third Edition.," 2002, "Wechsler Intelligence Scale for Children--Third Edition.," 2012); Vocabulary and Similarities subtests comprise the VCI and Block Design and Matrix Reasoning make up the PRI. Correlations between the WASI and WISC-III IQ's are: VIQ =.82, PIQ =.76, FSIQ-2 =.82, FSIQ-4 =.87(WASI; Wechsler, 1999). In the current study both the original WASI (n = 161) and the updated WASI-II (n = 139) were used. The Wechsler Intelligence Scale for Children-Fourth Edition (n = 15), the Kaufman Brief Intelligence Test (n =3) and the Wechsler Preschool and Primary Scale of Intelligence (n =3).

Executive function measures. The Controlled Oral Word Association Test (COWAT; Benton, Hamsher, & Sivan, 1983) assesses phonemic and semantic fluency. The examiner gives the child 60 seconds and asks him/her to name as many words as he/she can think of that begin with the letter F, A and S (phonemic) or to generate types of animals (semantic). The task is said to assess inhibitory control and response generation (Jurado & Rosselli, 2007).

The Trail Making Test (TMT), originally a part of the Army Individual Test Battery (1944), is thought to assess set-shifting/cognitive flexibility and inhibitory control. There are two portions to this test; Part A asks the child to draw a line connecting scattered numbers in numerical order, while Part B requires the child to toggle back and forth between numbers and letters, for example connecting 1-A-2-B etc. Each part is timed and the number of errors counted.

The Wisconsin Card-Sorting Test (WCST; Berg, 1948; Grant & Berg, 1948) was created as an assessment of abstract problem solving including set-shifting, working memory and inhibition. Although it was originally designed as an adult-specific measure, child norms were added in 1993 (Heaton, Chelune, Talley, Kay, & Curtiss, 1993). The test, presented via computer for this assessment, requires the child to match new cards with one of four original stimuli cards based on unspecified criteria; the child has to decide how to match the cards based on "correct" or "incorrect" feedback given by the computer. The "correct" matching criteria changes between color, form and number of shapes on the card. A meta-analysis of studies using the WCST with child and adolescent samples (Romine et al., 2004) reported that the WCST was able to successfully differentiate between clinical and non-clinical populations, although it was not able to make differential diagnoses within clinical populations (ADHD vs Conduct Disorder vs Mood Disorder etc.).

The Rey-Osterrieth Complex Figure Test (ROCFT; Rey, 1941) was created to assess visual memory for complex stimuli, as well as an individual's ability to plan and organize an approach to a visual-spatial task. Only the "Copy" portion of the test was consistently utilized in the current assessment. The task was developed and standardized

on a sample of children ages 5-14 and has excellent inter-rater reliability (0.91-0.96), and discriminant validity (Bernstein & Waber, 1996). Children were asked to copy a complex figure, and their approach to the task was noted. A successful copy will require both intact visual-spatial perception and fine motor skills, but also attention, planning and organization (Kirkwood, Weiler, Bernstein, Forbes, & Waber, 2010).

Conners' Continuous Performance Test-II (CPT-II; Conners, 2004) is a computerized test of sustained attention. Participants are asked to press the space bar on a computer keyboard every time a letter appears on the screen, except for the letter 'X.' The Commission score indicates how often the child cannot inhibit the prepotent response, and hits the space bar when an 'X' is displayed. This score is thought to be a measure of impulsivity/inhibitory control.

Stroop-Color-Word Test (SCWT; Stroop, 1935) is a paper measure thought to assess both cognitive set shifting and the ability to inhibit a dominant response in favor of a "novel" response (Homack & Riccio, 2004). There are three phases to the task each comprised of 45 seconds during which the child is supposed to read color words or describe the color of stimuli as quickly as possible. First the child is asked to read a list comprised of the words "red," "blue," and "green." Second, the child describes the color of a list of stimuli ("XXX") which are printed in red, blue or green. Finally, the child is presented with a list of the same color words, but the words are printed in a mismatched ink color; the child is asked to state the color of the ink. A meta-analysis of studies using the Stroop with child and adolescent populations suggested that the measure was able to discriminate between children with ADHD and other disorders affecting the frontal lobe

and typically developing children, but was not able to differentiate among clinical groups (Homack & Riccio, 2004).

Measures of seclusions and restraints. Emma Pendleton Bradley Hospital requires all incidents of restraint and seclusion to be documented in the medical record and reported to parents. Each staff member interacting with patients undergoes the same Safety Care training, which details the appropriate and safe use of specific holds and escorts; only these specific types of restraint are allowed. Thus provision and documentation of seclusions and restraints were standardized in these ways. Through a retrospective review of each child's medical record, the number of restrictive interventions was tallied including holds, escorts, seclusions and use of the papoose or 6-point board (i.e. mechanical restraints) for the admission under review. In addition to the total number of seclusions used, the total time each child spent in the seclusion room was summed. Total time in seclusion (Seclusion Time) is used in the data analyses, as it reflects deeper information about the child's behavior regulation (how quickly they were able to calm down once in the seclusion room). Additionally, the papoose and 6-point-board served similar functions and were each used depending on the child's age and size. Therefore, these two categories of restraint were combined into one variable: Mechanical Restraint.

Measures of trauma. The child's trauma history was assessed when s/he was admitted to the hospital. Nurses conducting the admission evaluation assessed for a history of three types of trauma specifically: physical abuse, neglect and sexual abuse. The perpetrator, time of occurrence and child protective service involvement were also reported. Methods for coding the presence of trauma were based on previous work

(Boxer and Terranova, 2008; Dupont Frechette, 2015; Lau et al., 2005), suggesting a hierarchical method for codifying a child's "primary" traumatic experience (neglect = 1, sexual abuse = 2, and physical abuse = 3).

Data Analyses

Characterization of the Sample

Descriptive statistics for both the NP and the no-NP Group were reviewed. Chi-square and independent t-tests were conducted to evaluate whether the NP or no-NP groups systematically differed across demographic variables. Descriptive statistics on the experience of restraints and seclusions within each group, including the average amount of time spent in seclusion, were also presented. Binary logistic regressions were used to assess whether R/S predicts NP vs. No-NP group membership. Finally, basic descriptive statistics from the neuropsychological assessment data are presented. Most neuropsychological data will be presented in z-score form, unless standard or scaled scores norms were published.

Association Between Demographic and Psychiatric Variables and Behavioral Dysregulation

Restraint and seclusion were measured as counts. As a result, models appropriate to represent the mean distributions for such variables were tested using a generalized linear regression approach. Specifically, Poisson and negative binomial distributions were considered. Where significant overdispersion was present in the model, as determined by a significance test of the alpha parameter for dispersion, negative binomial models were specified. An exposure variable was additionally added, accounting for each child's length of stay. These models were used to examine the relationship between

coded demographic and contextual variables that have been shown to predict increased likelihood of R/S in other studies, while accounting for length of stay. These variables include: age, gender, race/ethnicity, public insurance, history of aggression, history of abuse, previous psychiatric hospitalization and out-of-home placement.

Based on these results, I entered significant predictors hierarchically into a negative binomial regression model in order to assess the amount of variance in R/S accounted for by child and family variables.

Association Between Neuropsychological Data and Behavioral Dysregulation

Similarly, I conducted single-predictor negative binomial regressions with cognitive and EF z-scores predicting R/S variables, again accounting for length of stay as an exposure variable. Based on these results, I entered significant associations into a hierarchical negative binomial regression model, adding any relevant demographic/psychiatric variables into a final regression model.

Executive Functions Moderating Demographic/Psychiatric Factor's Effects on Behavioral Dysregulation

By examining how EF coefficients change once demographic variables were entered into the model, I identified potential interactions. I then utilized interaction terms within the negative binomial models to determine whether EF skills moderate the association between psychiatric/demographic variables and behavioral dysregulation.

Results

Neuropsychological Assessment Group (NP-Group)

Demographics. The final sample of children who received a neuropsychological assessment (n = 271) ranged in age from 66 months (5.5 years) to 165 months (13.75

years), with a mean age of 117.10 months (9.76 years; SD = 23.06 months). The sample was 72% male, and 62% identified as Caucasian. The primary language spoken by most children was English (98%).

Public versus private insurance was used as a gross proxy for socioeconomic status; in order to qualify for state-provided insurance, the family's income must be less than 250% of the Federal Poverty Level. Sixty-five percent of the children were covered under a public insurance provider. Family environment was operationalized as the environment and/or caregiver with whom the child lived directly prior to hospitalization (e.g. single mother, grandparents, residential facility). The majority of children lived in a household headed by a single mother (40%). Half of the children had an Individualized Education Plan at school. See Table 1 for demographic variables of NP and No-NP groups.

Psychiatric variables. In terms of family history, 82% were notable for a psychiatric history, and 27% had a history of substance abuse. Thirty-six percent of children had experienced one or more prior psychiatric inpatient hospitalizations (at Bradley Hospital or elsewhere). Regarding the current admission, Length of Stay (LOS) ranged from 3 to 146 days, with an average stay of 20.63 days (SD = 17.97). Diagnoses upon admission were documented for the NP Group; the majority of children had a diagnosis of ADHD (73%), and nearly half had a mood disorder diagnosis. Presenting concerns upon admission were additionally documented. The most common concern was aggressive or assaultive behavior (85%), followed by suicidal ideation (67%), self-injurious behavior (53%), homicidal ideation (43%) and sexualized behaviors (22%). See Table 2 for more detail.

Trauma variables. Fifty-two percent of children had a history of DCYF involvement in their family. In terms of abuse variables, 29% reportedly experienced physical abuse, 14% experienced sexual abuse, and 36% had experienced neglect.

No Neuropsychological Assessment Group

Demographics. The final sample of children who **did not** receive a neuropsychological assessment (n = 140) ranged in age from 84 weeks (7 years) to 160 weeks (13.3 years), with a mean age of 128.08 weeks (10.7 years; SD = 19.61 weeks). This subsample was 51% male, and 54% Caucasian. The primary language spoken by most children was also English (90%).

Seventy percent of the children were covered under a public insurance provider. Similar to the NP Group, the largest percentage of children lived in a household headed by a single mother (37%).

Psychiatric variable. In terms of family history, 81% were notable for a psychiatric history, and 40% had a family history of substance abuse. Twenty-seven percent of the children had a prior psychiatric inpatient admission, and 13% had a history of partial hospitalization. For the current hospitalization, LOS ranged between one and 72 days. The average LOS was 12.76 days (SD = 9.52; Table 2). Information regarding IEP status was not available for this group. Information regarding experience of abuse and/or neglect, as well as DCYF involvement was also not available for this group.

Demographic Variable Comparison: NP vs. No NP group

An independent sample t-test was conducted to assess whether child age differed between the NP and No-NP groups. Children referred for a neuropsychological assessment were younger than children who were not ($t(409) = 4.81$, $p < .001$). A chi-

squared test demonstrated a significant difference in gender between NP and No-NP groups (χ (1) = 17.089, $p < .001$); with a higher proportion of males in the NP group (72% vs 51%). Length of current hospitalization (LOS) was also significantly different between the NP and No-NP Groups, with children in the NP group having significantly longer stays than the No-NP Group ($t(405) = -4.83$, $p < .001$). There were no significant differences between groups across ethnic/racial composition, family/living environment, or insurance type (Table 3). Thus, children referred for neuropsychological testing were younger, more likely to be male, and had a longer LOS than children not referred for an assessment.

Neuropsychological Assessment Group -Restraints and Seclusions

Thirty-two percent of children in the NP Group experienced one or more holds. Range was between one and 103 holds during the single inpatient stay, with a mean of 3.40 (SD = 11.17) and median of 0. Thirty-six percent of children experienced an escort, with a range of one to 93 escorts during the current admission, a mean of 3.04 (SD = 9.14), and median of 0. In terms of mechanical restraints, 12% of children were placed in the papoose one or more times, with a range of one to 26 occasions. The average number of mechanical restraints was 0.42 (SD = 2.02); the median was 0. The 6-point board was used with 8% of children in the NP-Group, ranging from one to 53 times. The average number of 6-point board uses was 0.63 (SD = 3.92), with a median of 0. Seclusions ranged from zero to 84, with 35% of children experiencing at least one. The average number of seclusions was 2.86 (SD = 8.42); the median was 0. The average amount of time spent in seclusion was 44.27 minutes (SD = 147.71). See Table 4 for a summary of R/S data for NP Group.

No-Neuropsychological Assessment Group- Restraints and Seclusions

Fifteen percent of children in the No-NP Group experienced one or more hold. Range was between one and 43 holds during the single inpatient stay, with a mean of 1.23 (SD = 4.84). Median across holds, escorts, seclusion was 0. Eighteen percent of these children experienced an escort, with a range of one to 27 escorts during the current admission, a mean of 1.28 (SD = 4.17). In terms of mechanical restraints, 6% of children were placed in the papoose one or more times, with a range of one to 13 occasions. The average number was 0.21 (SD = 2.02). The 6-point board was used with 4% of children in the No-NP Group, ranging from one to 8 times. Average number of uses was 0.14 (SD = 0.88). Seclusions ranged from zero to 16, with 17% of children experiencing at least one. The average number of seclusions was 0.93 (SD = 2.76). The average amount of time spent in seclusion over the current admission was 13.32 minutes (SD = 44.09). See Table 5 for summary of R/S data in No-NP Group.

Restraint and Seclusions Comparison: NP vs. No-NP Group

A series of separate binary logistic regression analyses were conducted to predict NP or No-NP group membership using hold, escort, 6-point board, papoose and seclusion data as predictors. Binary logistic regression was deemed appropriate, and met all assumptions necessary including: dichotomous dependent variable with exclusive and exhaustive categories and independence of observations. Each R/S variable was tested independently, therefore multicollinearity was not a problem. Cook's distances for each model were less than 1.

Holds. The number of holds a child experienced during the inpatient stay significantly predicted group membership, with an odds ratio (OR) of 1.04 (se = .02, p =

.046, CI = 1.001- 1.09). Suggesting that for each hold experienced, the odds of a child belonging to the NP group increased by 4%. Nagelkerke's R^2 was .02.

Escorts. Similarly, number of escorts significantly predicted group membership (OR = 1.09, se = .02, p = .04, CI = 1.002 – 1.10). Nagelkerke's R^2 was .04 of variance in sample group.

Seclusion. Total number of seclusions significantly predicted group membership. Odds ratio indicated that for each additional seclusion, the odds of a child belonging to the NP group was 10% higher (OR = 1.10, se = .04, p = .01, CI = 1.02 – 1.17). R^2 was .04.

Seclusion Time. Regarding time in seclusion, odds ratio indicated that for each additional minute in seclusion, odds were 1% higher that the child belonged to the NP group (OR = 1.01, se = .002, p = .01, CI = 1.001 – 1.011). Nagelkerke's R^2 was .04

Mechanical Restraint. The number of mechanical restraints a child experienced during his/her inpatient stay did not significantly predict NP group membership (OR = 1.08, se = .05, p = .14, CI = 0.97 - 1.19).

Neuropsychology Assessment Data

Descriptive statistics for neuropsychological assessment tasks is presented in Table 7.

Cognitive. Ninety-five percent of the NP group received a cognitive measure (n = 258). Children received a variety of cognitive assessments based on the referral question, with the majority of children completing the WASI/WASI-II (n = 235; 91%). For breakdown see Table 6.

Executive Functioning. Descriptive statistics for both cognitive and EF assessment tasks are presented in Table 7. The average cognitive scores (FSIQ, VCI, PRI) were 8-9 points below the norming sample (Mean = 100), with similar standard deviations.

Demographic and Psychiatric Variables Predicting Behavioral Dysregulation

Holds. Demographic and psychiatric variables previously shown to be related to increased R/S were entered into a negative binomial regression model predicting Holds. Significant predictor variables included in the final model included age (IRR = 0.98, se = .01, $p < .001$), non-white race (IRR = 0.50, se = .14, p = .02), out-of-home placement (IRR = 10.49, se = 5.40, $p < .001$), and history of aggression (IRR = 4.52, se = 2.08, p = .001). Variables excluded from the final model were sex (IRR = 1.97, se = .73, p = .07), public insurance (IRR =1.48, se = .50, p = .25), having a previous psychiatric hospital admission (IRR = 1.48, se = .23, p = .36), and a history of abuse (IRR = 1.08, se = .35, p = .79). The dispersion parameter alpha was significant, suggesting that the negative binomial regression was preferred to the Poisson ($\alpha = 3.63$, se = .58, CI = 2.65-4.96, chibar2 (01) = 1155.81, p = 0.000).

Escorts. Significant variables in predicting Escorts were age (IRR = .98, se = .01, p = .001), and out-of-home placement (IRR = 8.05, se = 3.80, $p <.001$). Sex (IRR = 1.36, se = .46, p = .36), race (IRR = 0.62, se = .16, p = .07), public insurance (IRR = 1.15, se = .35, p = .65), previous admission (IRR = 1.01, se = .29, p = .97), history of aggression (IRR = 2.87, se = 1.17, p= .06) and history of abuse (IRR = 1.49, se = .23, p = .13) were excluded from the final model. The dispersion parameter alpha was significant ($\alpha = 2.96$, se = .48, CI = 2.15-4.06, chibar2 (01) = 735.28, p = 0.000).

Seclusion time. Similarly, significant variable in the model predicting Seclusion Time were age (IRR = .97, se = .01, p = .01), out-of-home placement (IRR = 10.05, se = 8.36, p = .01), aggression (IRR = 2.10, se = 1.19, p = .03). Sex (IRR = .89, se = .52, p = .85), race (IRR = .67, se = .29, p = .36), public insurance (IRR = .87, se = .47, p = .79), previous admission (IRR = 1.15, se = .56, p = .78) and history of abuse (IRR = 1.41, se = .67, p = .47) were excluded from the final model. The dispersion parameter alpha was significant (α = 10.25, se = 1.29, CI = 8.00 – 13.13, chibar2 (01) = 1.8e+04, p = 0.000).

Mechanical restraint. Aggression (IRR = 4.57, se = 3.29, p = .034) and out-of-home placement (IRR = 13.20, se = 8.79, p < .001) were the only significant variables in the model predicting Mechanical Restraint. The dispersion parameter alpha was significant (α = 5.85, se = 1.37, CI = 3.69 – 9.28, chibar2 (01) = 431.78, p = 0.000).

Neuropsychological Data Predicting Behavioral Dysregulation

Full scale cognitive scores did not significantly predict Holds, Escorts, Seclusion Time, or Mechanical Restraint, and therefore was not included in future models (Table 8). All alphas were greater than 0, with likelihood ration tests p < .05.

Executive function z-scores were individually entered into negative binomial regression models predicting Holds (Table 9) and accounting for exposure (Length of Stay). Stroop Color Word and WCST Total Categories were the only significant predictors. For every unit increase (1 SD) in Stroop Color Word, the child had 22% fewer holds. Contrary to the hypothesis, for every unit increase in WCST Total Categories, a child experienced 42% **more** holds. All alphas were greater than 0, with likelihood ration tests p < .05

The same approach was used to examine executive function scores' ability to predict Escorts, Seclusion Time and Mechanical Restraints. Similarly, lower Stroop Color Word scores were predictive of increased rate of Escorts (IRR = 0.78, se = .09, p = .036), and more WCST Categories completed was predictive of more Escorts (IRR = 1.36, se = .14, p = .002; Table 10). Seclusion Time was only significantly predicted by WCST Total Categories, with each SD increase in categories completed predicting 44% greater time spent in seclusion (Table 11). Mechanical Restraints were similarly predicted by Stroop Color Word scores (IRR = .58, se = .12, p = .01), WCST Total Categories (IRR = 1.72, se =.28, p = .001) and a trend for Semantic Fluency (IRR = .58, se = 17, p = .059; Table 12). All alphas were greater than 0, with likelihood ration tests $p < .05$

Demographic/Psychiatric Variables and EF Scores Predicting Dysregulation

Previously significant demographic and psychiatric variables were added to significant EF score models in step-wise fashion, to predict Holds, Escorts, Seclusion Time and Mechanical Restraints respectively, again accounting for exposure (Length of Stay). All alphas were greater than 0, with likelihood ration tests $p < .05$, confirming overdispersion.

Holds. The model started with EF factors (Stroop Color Word and WCST Categories) predicting holds. Age was added and then Race/Ethnicity. Once Race/Ethnicity was added to the model, WCST Categories was no longer a significant predictor (IRR = 1.29, se = .18, p = .07) and once Out-of-Home Placement was entered, Stroop Color Word was no longer significant (IRR = 0.92, se = .15, p = .602). The final model is shown in Table 13 (variables in order added). Out-of-Home Placement and being a child of color significantly increased the rate of Holds during admission.

Specifically, children of color had a 77% higher rate of holds, and children who had previously been in a residential setting were 10 times more likely to experience a hold during their admission.

Escorts. Age then Out-of-Home Placement were added to the EF model. Once Age was added, WCST was no longer significant, and once Out-of-Home Placement was added, neither EF variable was significant (Stroop: IRR = 0.77, se = .13, p = .123; WCST: IRR = 1.13, se = .16, p = .385). Once all variables were added, only Out-of-Home Placement and age significantly predicted number of escorts (Table 14).

Seclusion time. Age and then Out-of-Home Placement were added to WCST Categories in predicting total seclusion time. Again, once Out-of-Home Placement was added, other variables were no longer significant (Table 15). Children who had previously been in a residential setting had 10 times higher rates of seclusion time.

Mechanical restraint. Out-of-Home Placement and History of Aggression were added to the significant EF variables (Stroop, WCST Categories, Semantic Fluency) predicting mechanical restraints. Children with poorer semantic fluency experienced 50% more mechanical restraints and children from residential facilities experienced 20 times higher rates (Table 16).

Moderation

In order to test for moderation, interaction terms were created to examine whether EF variables moderated the effect of significant demographic/psychiatric variables on R/S. Interaction terms were entered into the previously described models including significant EF, demographic and psychiatric variables.

Holds. First, the interaction between Race/Ethnicity and WCST Categories score was examined. The interaction term (race/ethnicity X WCST) was tested in the model including Stroop, WCST Categories, Age, Race/Ethnicity, Out-of-Home Placement, and Aggression. The interaction term was not significant (IRR = 1.08, se = .30, p = .79, CI = 0.62 – 1.87), suggesting that WCST score does not moderate the relationship between race/ethnicity and number of holds.

The same procedure was followed to examine the interaction between Out-of-Home Placement and the Stroop task. An interaction term was not significant (IRR = 0.69, se = .27, p = .34, CI = .32 – 1.48).

Escorts. Two interaction terms were examined. First, Out-of-Home Placement X WCST was entered into the final model; the interaction term was not significant (IRR = 1.04, se = .16, p = .81, CI = 0.77 – 1.39). Second, the Out-of-Home Placement X Stroop interaction term was entered into the final model with WCST, Stroop, Age and Out-of-Home Placement. The second interaction term did not significantly predict escorts (IRR = 0.62, se = .26, p = .25, CI = .27 – 1.39).

Seclusions time. The interaction between Out-of-Home Placement and WCST was examined. The interaction term was not significant when entered into the final model (IRR = 1.39, se = .61, p = .45, CI = 0.59 – 3.31).

Mechanical Restraint. Two interaction terms were examined. First, Out-of-Home Placement X WCST was entered into the final model; the interaction term was not significant (IRR = 1.43, se = .51, p = .32, CI = 0.71 – 2.86). Second, the Out-of-Home Placement X Stroop interaction term was entered into the final model with WCST, Stroop, Semantic Fluency, Out-of-Home Placement and History of Aggression. The

second interaction term did not significantly predict experience of mechanical restraint (IRR = 0.55, se = .32, p = .30, CI = .18 – 1.69).

Discussion

The aims of the current study were two-fold. First, the study sought to examine the relationship between children's observable behavior dysregulation and performance on formal measures of EF. Second, the use of R/S in psychiatric inpatient settings has come under fire due to their invasive quality, potential to cause physical harm, as well as their conceivably detrimental effects on treatment (De Hert et al., 2011; Masters & Bellonci, 2002). Thus, the current study additionally sought to add to the growing literature identifying which children are at greater risk for experiencing R/S in a psychiatric inpatient setting.

The current study answered these questions by examining a sample of children referred for neuropsychological testing within Emma Pendleton Bradley Hospital's Psychiatric Inpatient Unit. It should be noted that children referred for testing were younger, more likely to be male, and had a longer LOS than children in the No-NP group. Children in the NP group were also more likely to experience holds, escorts, seclusions and longer seclusion time, but not mechanical restraint. The majority of children in both groups did not experience any kind of R/S during their admission.

There are multiple potential explanations for these differences between the referred and non-referred groups. Within this particular inpatient unit, children were frequently referred for neuropsychological assessment in order to clarify appropriate diagnoses and to assist with treatment planning. It may be that younger children were less likely to carry an appropriate diagnosis upon admission. For example, younger children

may not have had a prior assessment for ADHD or a mood disorder. Additionally, children who had more complex diagnostic presentations and/or did not respond to treatments as expected, were potentially more likely to be referred for testing to gain diagnostic clarity and to support improved treatment planning. These children may also have required longer LOS to achieve stabilization suggesting more severe mental health problems and/or increased family dysfunction. It is important to consider these differences when generalizing the findings to the broader psychiatric inpatient population.

Aim 1. Relationship Between Formal Measures of EF and Behavioral Dysregulation

In examining the first aim of the study, behavioral dysregulation was related to aspects of EF as measured by our neuropsychological tests. Specifically, my hypothesis that scores on tests of inhibition and cognitive flexibility would be negatively associated with greater R/S was partially supported. Poorer performance on the Stroop Color Word task predicted higher rates of holds (22%), escorts (22%), and mechanical restraints (42%). This result is somewhat in contrast to Comas (2012) who did not find a significant relationship between a Stroop task (DKEFS Color Word Interference) and R/S. Comas' sample was smaller (n = 43) and older (mean= 14.03 years, SD = 2.32) than the current sample. Additionally, data was analyzed differently; Comas' dependent variable was the total number of restraints and seclusions a child experienced divided by the total LOS. These differences may help account for the varied findings.

Barkley (1997) asserted that response inhibition was most associated with disinhibitory psychopathology. Previous studies have identified the Stroop Color Word task as a targeted test of one's ability to deliberately inhibit a dominant or automatic

response within a controlled setting (Miyake, et al., 2000). The Stroop task has also been shown to predict observable behavior in children. For example, children with impulsive/hyperactive symptoms of ADHD have been shown to have poorer performance on Stroop tasks, taking more time and making more errors (Barkley, 1997; Gorenstein, Mammato & Sandy, 1989; Willcutt, Doyle, Nigg, Faraone, & Pennington, 2005). Additionally, performance on the Stroop task has been shown to predict teacher and self-reported reactive aggression in school-age children (Ellis, Weiss & Lochman, 2009; Hecht, 2015), as well as teacher and parent reported externalizing behaviors over a 2 year period (Riggs, Blair, & Greenberg, 2004). Examining behavioral disinhibition (observable symptoms of substance use, conduct disorder, ADHD, and novelty seeking), Young and colleagues (2009) found a stronger association between behavior and response inhibition, measured via neuropsychological assessment, than with working memory or set-shifting tasks. However, across most studies the variance accounted for by formal measures of EF is small.

In direct contrast to my hypothesis, the current study also found that better performance (more categories completed) on the WCST predicted more holds (42%), escorts (36%), seclusion time (44%) and mechanical restraint (78%). There are several potential explanations for these counterintuitive findings. First, it is possible that in this population the task did not measure cognitive flexibility as hypothesized. Although typically thought of as a task of cognitive flexibility or set- shifting, performance on the WCST is complex and involves multiple processes including sustained attention, inhibitory control and working memory (Mikaye, et al., 2000). There may be a latent, unaccounted for, skill that the WCST taps into within this population such as processing

speed. A second possibility is that children with significant behavior dysregulation, at times, perform better on tasks of cognitive flexibility. Somewhat surprisingly, this is not the only study to find this result (Hecht, 2015). Hecht (2015) pointed to work suggesting inverse relationships between attention, impulse control and self-restraint, and cognitive flexibility (Friedman et al., 2007; Jones, Rothbart, & Posner, 2003). Less inhibitory control may "free up" a child's ability to generate multiple potential solutions and think more flexibly. Relatedly, WCST errors (perseverative or failure to maintain set) were not predictive of R/S; suggesting that it was not a child's ability to inhibit responses or keep response sets in mind that were ultimately related to R/S. However, this line of thinking is highly speculative and requires further assessment.

Poorer semantic fluency also predicted increased rates of mechanical restraint. Verbal fluency does not fit squarely within a single EF domain as delineated in the introduction (inhibitory control, working memory, cognitive flexibility). However, it is thought to come on line later in development (Best, 2010) and reportedly demonstrates integrity of neural connections and the functional integration of frontal systems with the rest of the brain (Anderson, 2010). Semantic fluency tasks additionally require some inhibitory skill, in order to generate words in one category while inhibiting words in another category. Therefore, this finding may be explained by its relation to integrity of frontal lobe circuitry, as well as in relation to inhibitory skills.

Joel Nigg (2017) recently wrote a review on the relationship between constructs related to self-regulation and EF. As outlined in the introduction of the current paper, Nigg reaffirmed that behavior regulation or self-regulation relies on a continuum of deliberate, top-down processes (e.g. EF), as well as intrinsic, bottom-up processes (e.g.

immediate cost/reward, incentive response systems). He additionally asserted that there is a temporal sequence in which EF skills are employed. Lower level EF skills such as inhibition and working memory are used to handle immediate conflicts or challenges, while higher level EF skills, such as cognitive flexibility and problem solving, are used to plan and consider future behavior. The current study was not designed to test this model, however, the results seem to fit within this framework. In this sample, poorer performance on an inhibition task predicted greater R/S. These data may suggest that although children may be able to problem solve about appropriate ways to deal with conflict or flexibly identify multiple ways of coping with anger in the future, in the moment they struggle to inhibit the prepotent reaction.

However, these findings must not be over stated; once demographic factors were entered into the models, EF scores were generally no longer significant, and EF scores were not found to moderate the relationship between demographic factors and R/S as hypothesized. Taken together, the results of this study suggest that the utility in using formal measures of EF to predict which kids will experience extreme behavior dysregulation is limited.

Aim 2. Predictors of Restraints and Seclusions in Child Inpatient Setting

The second broad aim of the current study was to replicate previous work and assess which demographic and psychiatric factors contribute to a child being at increased risk of experiencing R/S during their inpatient psychiatric stay. Although EF variables were predictive of R/S independently, this was not true once significant demographic and psychiatric variables were entered into the models. Similar to previous studies, the current study found that aspects of R/S were predicted by the child's age (Dean, Duke,

George, & Scott, 2007b; Gullick, McDermott, Stone, & Gibbon, 2005; Pogge, Pappalardo, Buccolo, & Harvey, 2013; Stellwagen & Kerig, 2009; Sourander, Ellilä, Välimäki, & Piha, 2002), race/ethnicity (Martin et al., 2008), history of residential placement (Dean et al., 2007b) and history of aggression (Dean et al., 2007b). Unlike previous studies, sex, abuse history, previous hospitalizations, and insurance type were not related to R/S.

Age. In the current sample of children ages 5 to 14 years, the child's age significantly predicted Escorts, and reached trend significance in predicting Holds. This finding is in line with much of the previous work, suggesting that younger children are more likely to experience R/S while inpatient. Younger children may have poorer behavioral regulation skills, and may have more difficulty engaging in coping skills than older children. Additionally, because they are smaller, staff may more readily utilize physical methods of restraining or moving younger children.

Race/Ethnicity. This study's finding, that even when holding all other psychiatric and demographic variables constant (age, sex, insurance type, residential placement, previous admission, history of aggression, history of abuse) children of color had a 77% higher rate of Holds, is striking although unfortunately not surprising. This same pattern has been documented in previous research (Donovan, Plant, Peller, Siegel, & Martin, 2003; Martin et al., 2008). Although it should be noted that not all studies find evidence of racial/ethnic differences (Delaney & Fogg, 2005).

Previous work has asserted that increased R/S amongst children of color can be attributed to reduced access to mental health services and appropriate treatment for minority groups (Donovan et al., 2003). Mental health service disparity, in all of its

complexity, is well documented (Alegría et al., 2008; Austin and Wagner 2010; Cook, Barry & Busch 2013), and likely plays a role in inpatient presentation. However, there are no studies to date linking reduced outpatient mental health treatment with increased R/S while inpatient. Unfortunately, the current study did not assess the severity of each child's psychiatric condition upon intake, and thus it is impossible to know whether racial/ethnic disparities are in any way accounted for by the severity of the child's mental health condition.

It is, of course, additionally important to consider the potential systemic factors at play. Although anecdotally the staff employed at Emma Pendleton Bradley is diverse and mirrors the population it serves, we cannot ignore the vast literature documenting that cultural bias systematically disadvantages youth of color (Paradies et al., 2015; Patcher & Coll, 2009). Recent publications have highlighted a similar pattern in United States' schools; specifically, that on a national level, children of color are more likely to experience R/S in school settings (U.S. Department of Education Office for Civil Rights, 2014). While the rules and regulations that govern R/S in schools are different from those that govern R/S in psychiatric hospital settings, we may be able to glean important information from this body of literature as it evolves. A full review of race/ethnicity's effects on child mental health is beyond the scope of the current paper; however, it is imperative that the insidious bias that pervades the systems in our culture, not be allowed to permeate children's mental health treatment within the highly controlled inpatient environment. Thus further, more specific work to address this question is required.

Residential Programs and R/S. The current study found that children who were transferred from a residential program to the inpatient unit demonstrated significantly

higher rates of R/S. Specifically, in the final models, children from residential programs experienced rates of Holds that were 2-times higher, Escorts that were 7-times higher, Seclusion Time that was 11-times longer, and Mechanical Restraint that was 21-times higher. Children coming from a residential program are at significant risk for R/S while inpatient, even after controlling for other demographic, psychiatric and cognitive variables.

Residential programs provide intensive supports for children and adolescents with serious emotional and behavioral problems. Children are often enrolled in these programs when they are not deemed safe to live at home, but do not require the acuity of inpatient hospitalization. Children in residential programs frequently fall into three categories: children with multiple severe mental and/or physical health problems, children with no caregivers, and children with significant maltreatment histories (Yampolskaya, Mowery, & Dollard, 2013). Thus, these children are likely to have more severe mental health problems, as well as carry multiple significant risk factors such as an abuse history or lacking a stable home environment. In some ways, residential treatment is an index of severe family dysfunction, which may predispose children to higher rates of dysregulation. Children, especially those without identified caregivers, are also likely to be discharged from the inpatient setting to a residential program. While on the inpatient unit, children are aware that if they successfully engage in behavior regulation, and avoid R/S, they are more likely to go home more quickly. However, if a child knows that he/she is not going "home," this may not be a motivating factor for them.

R/S is also used within many residential programs, without the same oversight as within hospitals. It is possible that children experience R/S within their residential

program prior to inpatient admission, and habituate to the experience. Future work should examine the longitudinal course of children who live in residential programs and are admitted to inpatient unit, in order to delineate this relationship more thoroughly.

Clinical Implications

Based on the current study, there are several populations of children at increased risk for R/S. Specifically younger children, children of color, children with experience in residential programs, and children with a prior history of aggression. The current study mirrors the results of previous work, lending added weight to the current findings and suggesting that working with these populations may require additional attention and training.

Several programs have demonstrated effectiveness at reducing R/S in children's inpatient units. A manualized treatment, Collaborative Problem Solving, "provides a framework to understand children's aggressive behavior as stemming from impairments in one of five non–mutually exclusive pathways" (EF, language processing, emotion regulation, cognitive flexibility, and social skills; Martin et al., 2008, pg. 1407). The treatment, focuses on using cognitive behavioral strategies to address the specific child's social and/or cognitive "pathway impairments," and ultimately reduce aggression. Another effective program, based on Positive Parenting Program, highlights staff training, individualized patient management plans, and using standardized behavior management strategies (Dean, Duke, George, & Scott, 2007). Based on the results of the current study, individualized behavior management plans that identify the child's goals and motivators would be extremely important, as well as training in cultural competence and identifying the individual child's triggers. Programs should take a highly data driven

approach to behavior management; this is made significantly easier because the units are already mandated to collect data on R/S. Data collection would allow staff to identify common triggers, as well as any problematic patient-staff interactions, and formally test the utility of behavior plans.

It would also be extremely important to pay close attention to supporting staff. There is significant literature on caregiver stress, and how it negatively impacts parents' relationships with children (Hayes & Watson, 2013). However, no work has examined the amount of stress inpatient staff experience, and how that may negatively impact staff mental health and staff-child interactions. Literature on parent stress and efficacy suggests that increasing understanding and empathy can improve parent-child interactions. Therefore, staff training may benefit from emphasizing how multiply at-risk children develop maladaptive coping strategies, and likely lack the ability to regulate their behavior appropriately. This may include more comprehensive trauma training (National Center for Traumatic Stress, 2012).

Limitations

The current study does have several limitations that should be noted. First regarding the sample, the study was conducted in a single hospital in a single inpatient unit, which necessarily limits the results' generalizability. As described above, there are national guidelines that govern the provision of R/S within inpatient settings, which lends some degree of stability across sites; however, there is significant variability in populations served, staff training and even workplace culture. The majority of studies on R/S have examined single inpatient units (De Hert et al., 2011; Martin et al., 2008; Tompsett et al., 2011) or multiple units within the same hospital (Delaney & Fogg,

2005); therefore future work may benefit from examining hospitals within a particular state or region. The current study additionally focused entirely on variables related to the child, and did not account for staff or hospital level variables that may influence R/S. Although previous work examined the time of day and when in a child's LOS R/S most frequently occur (Delaney & Fogg, 2005), no study to date has thoroughly examined precipitating events or staff characteristics/behaviors related to decreased incidence of R/S.

Related to assessment and measurement, the current study relied on retrospective chart review. Many of the demographic and psychiatric variables were identified in the child's admission evaluation; although the content is generally standardized, there is inherent variability within these documents which led to some missing data. Additionally, not every child received a neuropsychological assessment. Although I examined the differences between NP and No-NP groups, it is possible that these groups systematically differ in neuropsychological profile. I also did not examine medication as part of the current study. The majority of children were on some form of medication during their inpatient stay, and these medications may have had an effect on the child's neuropsychological profile, and may explain some of the null findings. For example, performance on the CPT may be improved by stimulant medications to treat ADHD (Swanson, Baler, & Volkow, 2011). Future work should account for these potential confounds. Finally, the current study did not include any behavior rating scales of EF (e.g. BRIEF-2). The addition of behavior rating scales would help to clarify the relationship between measurement, neurocognitive profile and behavior.

Future Directions

Future studies assessing the relationship between behavior dysregulation and EF tests should use multiple EF measures examining the same latent constructs (e.g. inhibition, working memory, cognitive flexibility) in order to decrease the influence of random measurement errors, or systematic errors inherent in a specific task. Additionally future work should utilize different types of EF measures including parent/teacher/provider report questionnaires, and tasks with greater ecological validity (Anderson, 2002). Based on Nigg's recent review and call-to-action, future work examining the relationships between EF and behavior regulation should work to operate within the same framework and use the same terms (i.e. EF vs. effortful control).

Future studies focused on decreasing R/S within inpatient settings should examine multiple inpatient hospitals within the same state or region in order to increase generalizability. Additionally, it will be important to examine the interactions between staff and patients. Research should follow children longitudinally to assess how early experiences may have cascading effects that lead to increased behavior dysregulation over time.

Conclusion

This study examined the relationship between children's observable behavior dysregulation and performance on formal measures of EF within a psychiatric inpatient population. Performance on a task of inhibitory control was inversely predictive of increased holds, escorts and mechanical restraints; while counter to my hypothesis, a task of cognitive flexibility was positively predictive of holds, escorts, seclusion time and mechanical restraints. This study additionally examined demographic and psychiatric factors that predicted R/S. The child's age, race/ethnicity, history of an out-of-home

placement and history of aggression predicted R/S above and beyond EF skills. Therefore, although EF skills may contribute to behavior dysregulation, we must be careful when making predictions based on performance-based measures; it is additionally imperative to consider a child's specific context.

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Table 1

Descriptive Statistics for Child Demographic Characteristics

Demographic Category	NP Group	No-NP Group
	Mean (SD)	Mean (SD)
Age	117.10 (23.06)	128.08 (19.61)
	n (%)	n (%)
Sex		
Male	195 (72%)	72 (51%)
Female	76 (28%)	68 (49%)
Race/Ethnicity	n = 169	n = 126
African American	25 (9%)	19 (14%)
Hispanic	49 (18%)	25 (18%)
Caucasian	169 (62%)	76 (54%)
Asian	2 (1%)	2 (1%)
Multiracial	24 (9%)	4 (3%)
Living Environment		
Single mother	106 (39%)	53 (38%)
Mother and step-parent	43 (16%)	15 (11%)
Residential Setting	18 (7%)	6 (4%)
Biological Parents	47 (17%)	28 (20%)
Adoptive Family	15 (6%)	9 (6%)
Foster Family	10 (4%)	6 (4%)
Grandparents	15 (6%)	2 (1%)
Single Father	10 (4%)	2 (1%)
Father and Step-Parent	3 (1%)	5 (4%)
Other relative	3 (1%)	3 (2%)
Homeless Shelter	1 (< 1%)	
Insurance	n = 256	n = 135
Public	175 (68%)	96 (71%)
Private	81 (32%)	39 (29%)

Table 2

Descriptive Statistics for Child Psychiatric Variables

Psychiatric History	NP Group	No-NP Group
Prior Inpatient Admission	n = 267	
Yes	96 (36%)	45 (32%)
No	171 (64%)	95 (68%)
Number Inpatient Admissions	n = 267	
0	171 (64%)	95 (68%)
1	64 (24%)	30 (24%)
2	20 (7%)	7 (5%)
3	7 (3%)	3 (2%)
4	2 (1%)	3 (2%)
5	2 (1%)	2 (1%)
> 6	1 (< 1%)	-
Current Admission	Mean (SD)	Mean (SD)
Length of Current Admission	20.63 (17.97)	12.76 (9.52)
Diagnosis at Admission		
Externalizing Disorder	n = 263	
Yes	48 (18%)	-
No	215 (82%)	
Mood Disorder	n = 253	
Yes	116 (46%)	-
No	137 (54%)	
ADHD	n = 263	
Yes	192 (73%)	-
No	71 (27%)	
PTSD	n = 269	
Yes	43 (16%)	-
No	226 (84%)	
ASD	n = 262	
Yes	21 (8%)	-
No	241 (92%)	
Symptom at Admission (n = 262)		
Suicidal Ideation	175 (67%)	-
Homicidal Ideation	113 (43%)	-
Self-Injurious Behavior	140 (53%)	-
Aggression/Assaultive Behavior	222 (85%)	-
Sexualized Behavior	57 (22%)	-

Table 3

Comparison of Demographic Characteristics Between NP and No-NP Groups

Demographic Variable	**n**	**NP Group (n = 271)**	**No-NP Group (n = 140)**	
		Mean (SD)	Mean (SD)	t
Age	411	117.10 (23.06)	128.08 (19.61)	4.806 ***
Length of Stay	407	20.63 (17.97)	12.76 (9.52)	-4.830***
		%	%	χ^2
% Male	411	72%	51%	17.089***
% Caucasian	396	62%	54%	0.188
% Public Insurance	391	68%	71%	.315
Prior Admission(s)	407	36%	27%	3.229
% Out of Home Placement	411	7%	4%	0.932

*p < .05, **p<.01, ***p<.001

Table 4

Descriptive Statistics for Restraint and Seclusions in NP and No-NP Groups

Type of Restrictive Intervention	Percent Experienced		Range		Mean (SD)	
	NP	No-NP	NP	No-NP	NP	No-NP
Holds	32%	15%	0-103	0 - 43	3.40 (11.17)	1.23 (4.84)
Escorts	36%	18%	0 - 93	0 - 27	3.04 (9.14)	1.28 (4.17)
Six-point Board	8%	4%	0 - 53	0 - 8	0.63 (3.92)	0.14 (0.88)
Papoose	12%	6%	0 - 26	0 - 13	0.42 (2.02)	0.21 (1.27)
Seclusion	35%	17%	0 - 84	0 - 16	2.86 (8.42)	0.93 (2.76)
Seclusion Time (minutes)	35%	17%	0 - 1567	0 -274	44.27 (147.71)	13.32 (44.09)

Table 5

Cognitive Measures Used in NP Group

Cognitive Measure	n	Percentage
WASI	74	29%
WASI-II	161	62%
WISC-IV	15	6%
WPPSI-IV	4	2%
K-BIT	3	1%

Table 6

Descriptive Statistics for Neuropsychological Assessment Data

Test	N	Range	Mean (SD)
Cognitive Measure		**Scaled Score**	
FSIQ	253	57 – 126	91.57 (14.08)
VCI	253	54 – 128	92.75 (14.14)
PRI	253	55 – 133	91.89 (14.26)
Verbal Fluency		**z-score**	
Semantic Fluency	226	-4.06 – 2.63	-0.40 (1.17)
Phonetic Fluency	222	-3.35 – 3.39	-0.59 (1.22)
WRAML		**Standard Score**	
Sentence Repetition	238	1 – 19	9.09 (2.82)
		z-score	
Rey-Osterieth Copy	188	-6.30 – 1.80	-1.08 (1.32)
Trail Making Test			
Trails A	241	-5.11 – 7.10	-0.08 (1.40)
Trails B	221	-7.41 – 2.05	-0.48 (1.46)
Stroop Color Word Test		**t-score**	
Words	214	20 – 85	50.19 (9.97)
Colors	214	20 – 78	43.64 (9.39)
Color-Word	206	12 – 97	38.12 (12.12)
CPT			
Omissions	183	29 – 176	63.47 (22.40)
Commissions	183	19 – 72	52.75 (8.50)
Wisconsin Card Sort Task		**z-score**	
Categories Completed	198	-7.47 – 1.56	-1.61 (1.85)
Perseverative Errors	187	-4.62 – 2.15	0.28 (1.06)
Failure to Maintain Set	193	-7.35 – 1.60	0.32 (1.17)

Table 7

Negative Binomial Regression: Full Scale IQ Predicting R/S

Seclusion/Restraint Variable	IRR	se	p	95% CI	
Holds	1.23	.01	.298	0.99	1.04
Escorts	1.00	.01	.866	0.98	1.03
Seclusion Time	1.01	.02	.531	0.97	1.05
Mechanical Restraint	1.03	.02	.071	0.99	1.07

IRR = incident rate ratio; se = standard error; CI = confidence interval; *p < .05, **p<.01, ***p<.001

Table 8

Negative Binomial Regression: EF Scores Predicting Holds

Predicting Holds	IRR	se	p	95% CI	
Sentences	1.01	.19	.970	0.69	1.45
Rey Copy	1.22	.23	.278	0.85	1.76
Trails B	0.92	.13	.54	0.70	1.20
Trail B Errors	0.95	.06	.38	0.84	1.07
Phonetic Fluency	1.26	.17	.09	0.96	1.64
Semantic Fluency	0.87	.12	.34	0.66	1.15
Stroop Color Word	0.78	.09	.044*	0.61	0.99
CPT Commissions	1.34	.24	.10	0.95	1.90
WCST Category	1.42	.16	.002**	1.14	1.77
WCST PE	.94	.24	.79	0.56	1.55
WCST FMS	.97	.19	.87	.66	1.43

IRR = incident rate ratio; se = standard error; CI = confidence interval; *p < .05, **p<.01, ***p<.001

Table 9

Negative Binomial Regression: EF Scores Predicting Escorts

Predicting Escorts	IRR	se	p	95% CI	
Sentences	1.04	.17	.833	0.75	1.43
Rey Copy	1.17	.19	.342	0.85	1.59
Trails B	0.88	.11	.339	0.69	1.13
Trail B Errors	0.97	.06	.650	0.87	1.09
Phonetic Fluency	1.15	.13	.235	0.91	1.44
Semantic Fluency	0.82	.10	.103	0.64	1.04
Stroop Color Word	0.78	.09	.036*	0.62	0.98
CPT Commissions	1.23	.21	.221	.88	1.74
WCST Category	1.36	.14	.002**	1.12	1.67
WCST PE	.89	.17	.573	0.62	1.31
WCST FMS	1.07	.18	.686	0.77	1.48

IRR = incident rate ratio; se = standard error; CI = confidence interval; *p < .05, **p<.01, ***p<.001

Table 10

Negative Binomial Regression: EF Scores Predicting Seclusion Time

Predicting Seclusion Time	IRR	se	p	95% CI	
Sentences	1.09	.29	.754	0.65	1.83
Rey Copy	1.18	.30	.523	0.71	1.94
Trails B	.924	.18	.687	0.63	1.36
Trail B Errors	.929	.09	.462	0.76	1.13
Phonetic Fluency	1.18	.22	.362	0.82	1.71
Semantic Fluency	1.00	.20	.985	0.67	1.49
Stroop Color Word	.845	.15	.335	0.60	1.19
CPT Commissions	1.01	.29	.797	0.63	1.83
WCST Category	1.44	.21	.011*	1.08	1.90
WCST PE	.922	.28	.789	0.51	1.67
WCST FMS	1.08	.28	.775	0.64	1.81

IRR = incident rate ratio; se = standard error; CI = confidence interval; *p < .05, **p<.01, ***p<.001

Table 11

Negative Binomial Regression: EF Scores Predicting Mechanical Restraints

Predicting Mechanical Restraint	IRR	se	p	95% CI	
Sentences	.964	.27	.712	0.50	1.60
Rey Copy	1.14	.29	.621	0.68	1.89
Trails B	.792	.16	.252	0.53	1.18
Trail B Errors	.909	.09	.353	0.74	1.11
Phonetic Fluency	1.28	.27	.237	0.85	1.94
Semantic Fluency	.575	.17	.059†	0.32	1.02
Stroop Color Word	.584	.12	.010*	0.39	0.88
CPT Commissions	1.302	.29	.232	0.84	2.01
WCST Categories	1.720	.28	.001**	1.25	2.37
WCST PE	1.049	.38	.893	0.52	2.12
WCST FMS	.945	.27	.842	0.54	1.65

IRR = incident rate ratio; se = standard error; CI = confidence interval; *p < .05, **p<.01, ***p<.001

Table 12

Negative Binomial Regression: Demographic, Psychiatric and EF Variables Predicting Holds

Predicting Holds	IRR	se	p	95% CI	
Stroop Color Word	0.88	.14	.426	0.65	1.20
WCST Categories	1.17	.16	.233	0.90	1.53
Age	0.98	.01	.052†	0.96	1.00
Caucasian	0.23	.078	< .001***	0.11	0.45
Out-of-Home Placement	11.89	8.04	< .001***	3.16	44.73
History of Aggression	2.42	1.38	.213	0.79	7.41

IRR = incident rate ratio; se = standard error; CI = confidence interval; *p < .05, **p<.01, ***p<.001

Table 13

Negative Binomial Regression: Demographic, Psychiatric and EF Variables Predicting Escorts

Predicting Escorts	IRR	se	p	95% CI	
Stroop Color Word	0.78	.13	.123	0.56	1.09
WCST Categories	1.13	.16	.385	0.83	1.47
Age	0.98	.01	.033*	0.96	0.99
Out-of-Home Placement	7.50	5.62	.007**	1.73	32.58

IRR = incident rate ratio; se = standard error; CI = confidence interval; *p < .05, **p<.01, ***p<.001

Table 14

Negative Binomial Regression: Demographic, Psychiatric and EF Variables Predicting Seclusion Time

Predicting Seclusion Time	IRR	se	p	95% CI	
WCST Categories	1.19	.22	.336	0.83	1.73
Age	0.97	.01	.064	0.95	1.00
Out-of-Home Placement	11.19	12.38	.029*	1.28	97.74
History of Aggression	2.88	2.18	.162	0.65	12.67

IRR = incident rate ratio; se = standard error; CI = confidence interval; *p < .05, **p<.01, ***p<.001

Table 15

Negative Binomial Regression: Demographic, Psychiatric and EF Variables Predicting Mechanical Restraints

Predicting Mechanical Restraint	IRR	se	p	95% CI	
Stroop Color Word	1.15	.29	.576	0.71	1.87
WCST Categories	1.29	.22	.125	0.93	1.79
Semantic Fluency	0.53	.15	.031*	0.30	0.94
Out-of-Home Placement	21.54	18.91	< .001***	3.85	120.42
History of Aggression	1.34	1.06	.712	0.28	6.32

IRR = incident rate ratio; se = standard error; CI = confidence interval; *p < .05, **p<.01, ***p<.001

Table 16

Negative Binomial Regression: Interaction Between Race and WCST Predicting Holds

Predicting Holds	IRR	se	p	95% CI	
Stroop Color Word	0.88	.14	.403	0.64	1.20
WCST Categories	1.13	.23	.570	0.75	1.69
Age	0.98	.01	.050	0.96	1.00
Caucasian	0.25	.14	.011*	0.09	0.73
Out-of-Home Placement	12.66	9.06	< .001***	3.11	51.50
History of Aggression	2.39	1.37	.129	0.78	7.38
Race xWCST Categories	1.08	.30	.786	0.62	1.87

IRR = incident rate ratio; se = standard error; CI = confidence interval; *p < .05, **p<.01, ***p<.001

Table 17

Negative Binomial Regression: Interaction Between Out-of-Home Placement and Stroop Color Word Predicting Holds

Predicting Holds	IRR	se	p	95% CI	
Stroop Color Word	0.94	.16	.720	0.68	1.31
WCST Categories	1.14	.16	.329	0.87	1.50
Age	0.98	.01	.05	0.96	0.99
Caucasian	0.24	.083	< .001***	0.12	0.47
Out-of-Home Placement	5.51	5.13	.067	0.89	34.17
History of Aggression	2.49	1.42	.109	0.82	7.60
Out-of-Home x SCW	0.69	.27	.338	0.32	1.48

IRR = incident rate ratio; se = standard error; CI = confidence interval; *p < .05, **p<.01, ***p<.001

Table 18

Negative Binomial Regression: Interaction Between Out-of-Home Placement and Stroop Color Word Predicting Escorts

Predicting Escorts	IRR	se	p	95% CI	
Stroop Color Word	0.84	.15	.331	0.59	1.19
WCST Categories	1.09	.16	.571	0.82	1.45
Age	0.98	.01	.029*	0.96	0.99
Out-of-Home Placement	2.87	2.72	.265	0.45	18.41
Out-of-Home x SCW	0.62	.26	.614	0.08	4.62

IRR = incident rate ratio; se = standard error; CI = confidence interval; *p < .05, **p<.01, ***p<.001

Table 19

Negative Binomial Regression: Interaction Between Out-of-Home Placement and WCST Categories Predicting Escorts

Predicting Escorts	IRR	se	p	95% CI	
Stroop Color Word	0.81	.13	.214	0.59	1.13
WCST Categories	1.04	.16	.812	0.77	1.39
Age	0.98	.01	.022*	0.96	0.99
Out-of-Home Placement	18.29	18.88	.005**	2.42	138.37
Out-of-Home x WCST	1.99	.85	.107	0.86	4.61

IRR = incident rate ratio; se = standard error; CI = confidence interval; *p < .05, **p<.01, ***p<.001

Table 20

Negative Binomial Regression: Interaction Between Out-of-Home Placement and WCST Categories Predicting Seclusion Time

Predicting Seclusion Time	IRR	se	p	95% CI	
WCST Categories	1.13	.24	.562	0.75	1.70
Age	0.97	.01	.051	0.95	1.00
Out-of-Home Placement	18.19	26.02	.042*	1.10	300.09
History of Aggression	2.97	2.25	.151	0.67	13.08
Out-of-Home x WCST	1.39	.61	.445	0.59	3.31

IRR = incident rate ratio; se = standard error; CI = confidence interval; *p < .05, **p<.01, ***p<.001

Table 21

Negative Binomial Regression: Interaction Between Out-of-Home Placement and WCST Categories Predicting Mechanical Restraint

Predicting Mechanical Restraint	IRR	se	p	95% CI	
Stroop Color Word	1.17	.29	.497	0.73	1.89
WCST Categories	1.17	.22	.383	0.82	1.68
Semantic Fluency	0.57	.17	.056	0.33	1.01
Out-of-Home Placement	34.21	35.76	.001**	4.41	265.35
History of Aggression	1.46	1.14	.627	0.32	6.77
Out-of-Home x WCST	1.43	.51	<.001***	0.00	0.05

IRR = incident rate ratio; se = standard error; CI = confidence interval; *p < .05, **p<.01, ***p<.001

Table 22

Negative Binomial Regression: Interaction Between Out-of-Home Placement and Stroop Color Word Categories Predicting Mechanical Restraint

Predicting Mechanical Restraint	IRR	se	p	95% CI	
Stroop Color Word	1.28	.35	.353	0.76	2.18
WCST Categories	1.25	.21	.197	0.89	1.74
Semantic Fluency	0.57	.16	.051†	0.32	1.00
Out-of-Home Placement	6.62	8.19	.127	0.58	74.94
History of Aggression	1.50	1.19	.608	0.32	7.12
Out-of-Home x WCST	0.55	.32	.301	0.18	1.69

IRR = incident rate ratio; se = standard error; CI = confidence interval; *p < .05, **p<.01, ***p<.001